Small Business Innovation Research/Small Business Tech Transfer

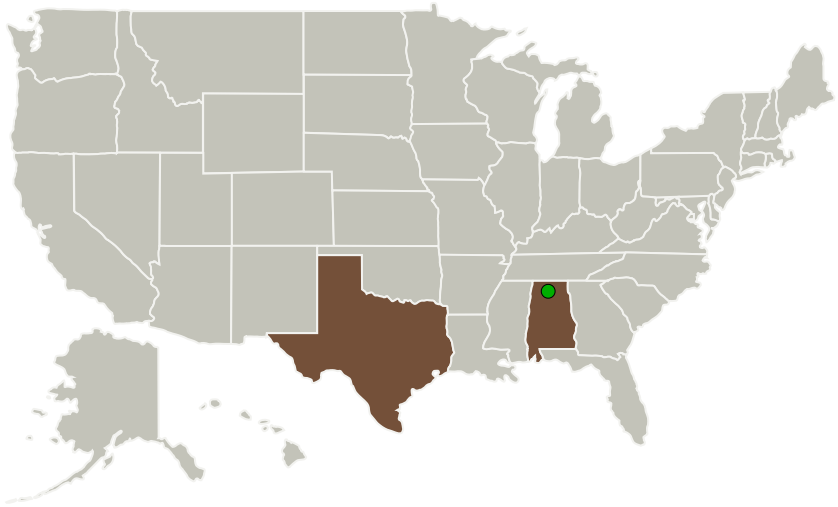
Additive Manufactured Very Light Weight Diamond Turned Aspheric Mirror, Phase I

Completed Technology Project (2015 - 2015)

Project Introduction

Selective laser melting, referred to as "Direct Metal Laser Sintering"(DMLS), "Metal Powder Bed Fusion" or "3D Printing" is an additive manufacturing process which allows extremely thin wall and complex structures. Off-axis aspherics are as easily produced as simple spherical optical surfaces. Nickel 11-13 % phosphorus alloy is the only hard, very fine grain, corrosion resistant material that can be diamond turned and polished to ultra smooth surfaces. Diamond turning produces any aspheric surface to visible optical tolerances. Finishes of 0.6nm rms have been diamond turned on NiP alloy without post polishing. Very low cutting force of diamond turning allows a mirror faceplate to be very thin without print-through of the internal support structure. The innovation uses proven steel, stainless steel and superalloy powder additive manufacturing to make mirror substrates with near perfect thermal expansion match with electroplated NiP coating. It is fabrication of low cost, light weight large aperture mirrors by three processes. 1. Additively manufactured mirror substrates very close to net shape. 2. Electroplated NiP alloy covers contours of the mirror substrates with thickness to allow diamond turning, no machining of mirror substrate required. 3. Diamond turning can produce the mirror segment contour to visible tolerances.

Primary U.S. Work Locations and Key Partners



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Completed Technology Project (2015 - 2015)

Organizations Performing Work	Role	Type	Location
Dallas Optical Systems, Inc.	Lead Organization	Industry Veteran-Owned Small Business (VOSB)	Rockwall, Texas
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Texas

Project Transitions

June 2015: Project Start

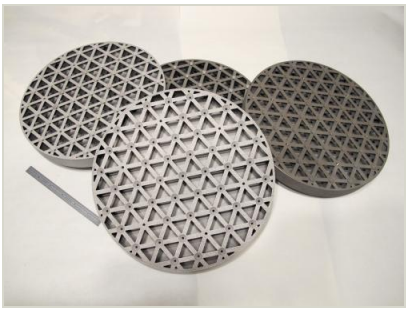
December 2015: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138773)*

Images

Briefing Chart
Additive Manufactured Very Light Weight Diamond Turned Aspheric Mirror Briefing Chart
(https://techport.nasa.gov/image/135639)



Final Summary Chart Image
Additive Manufactured Very Light Weight Diamond Turned Aspheric Mirror, Phase I Project Image
(https://techport.nasa.gov/image/127992)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Dallas Optical Systems, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

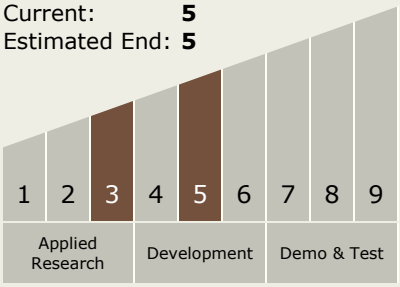
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
John M Casstevens

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



Additive Manufactured Very Light Weight Diamond Turned Aspheric Mirror, Phase I

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Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.1 Mirror Systems